

Fig.1

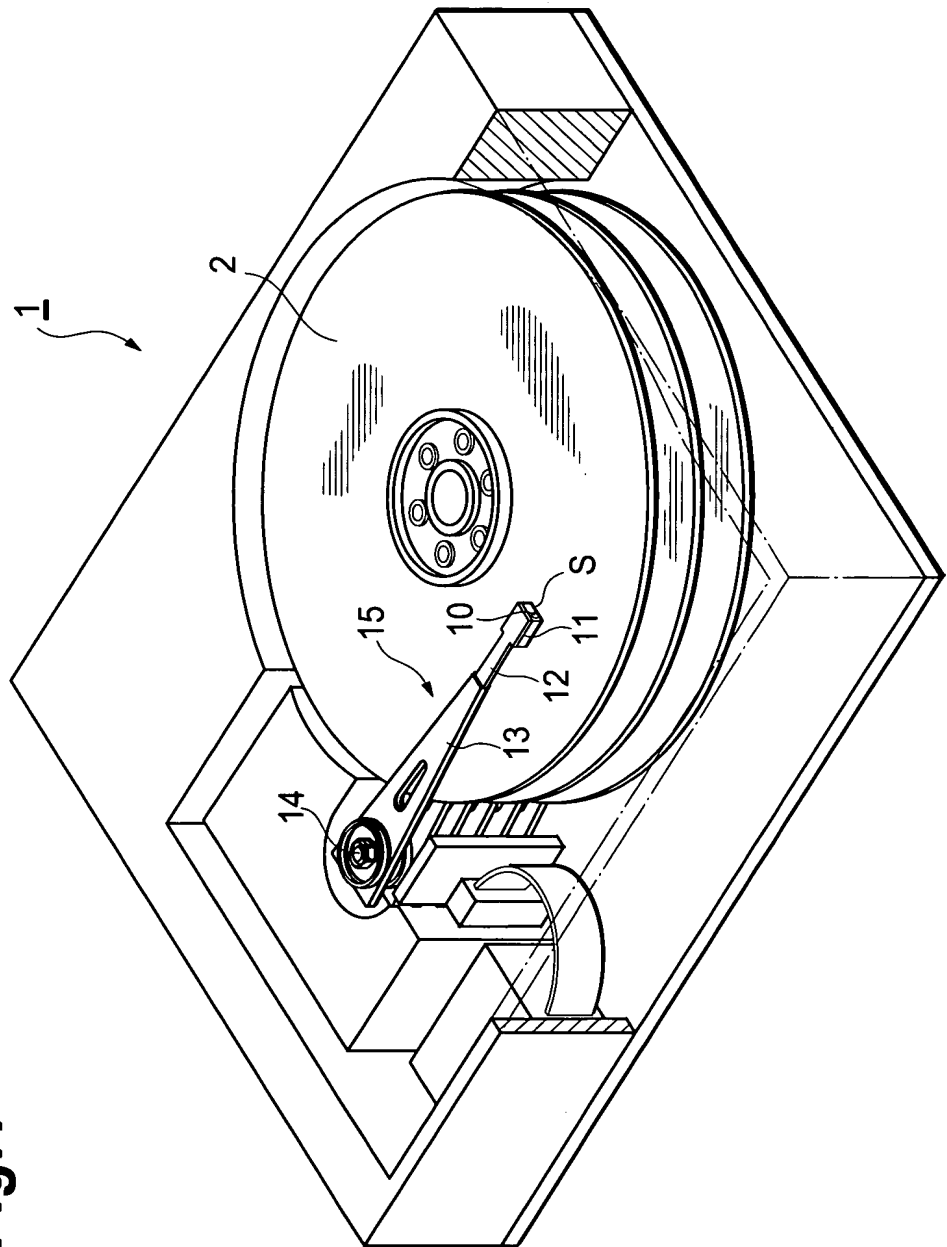


Fig.2

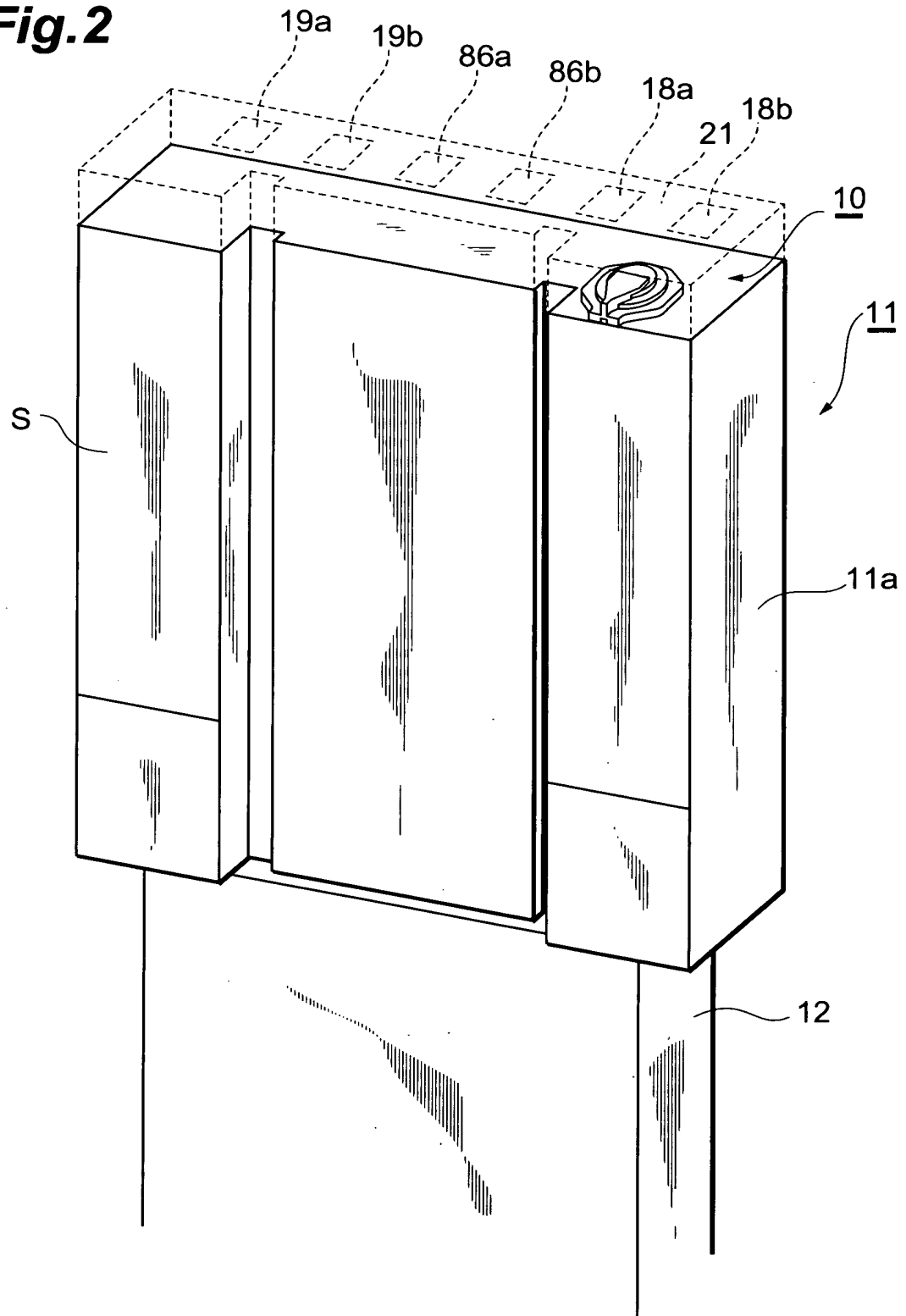
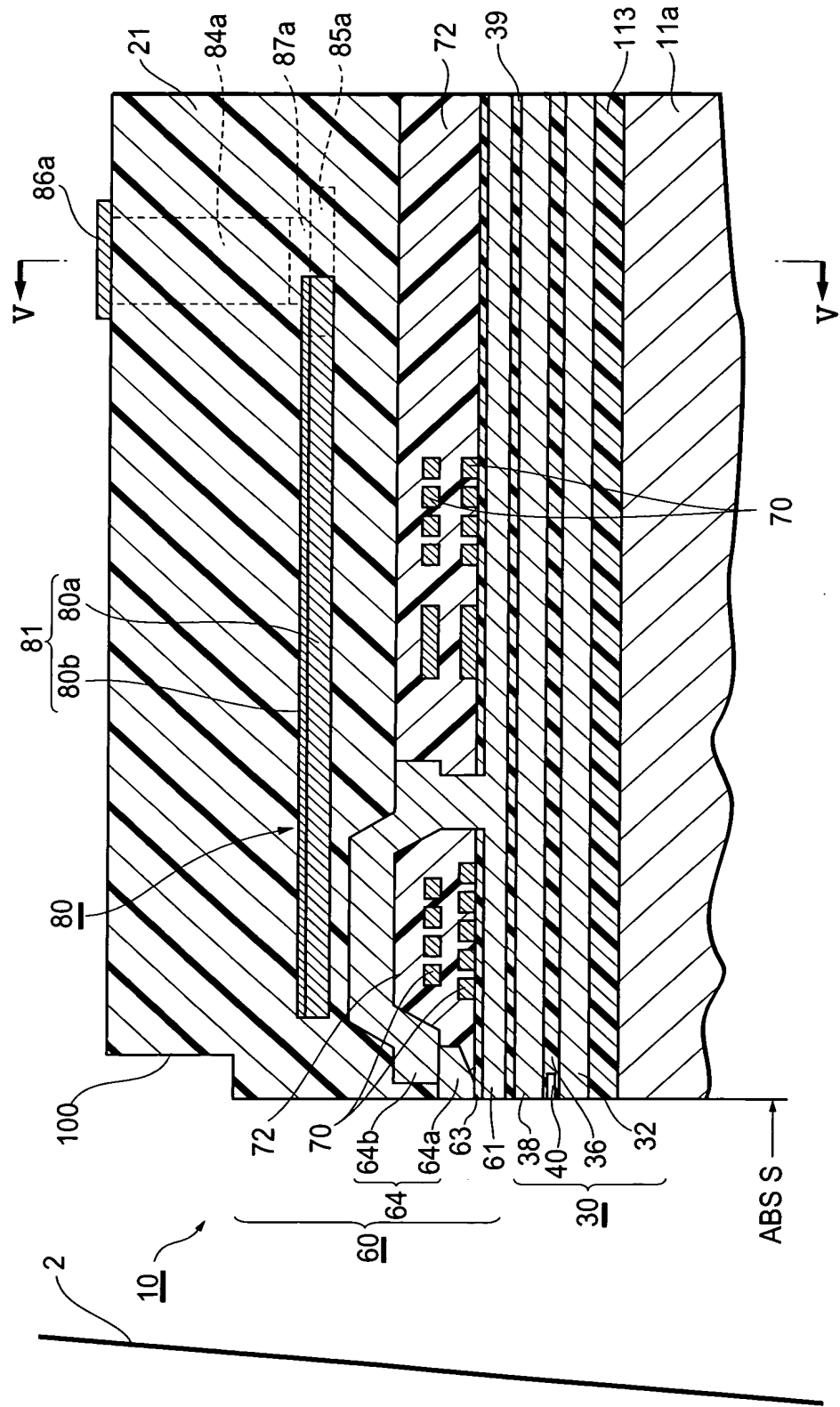


Fig. 3



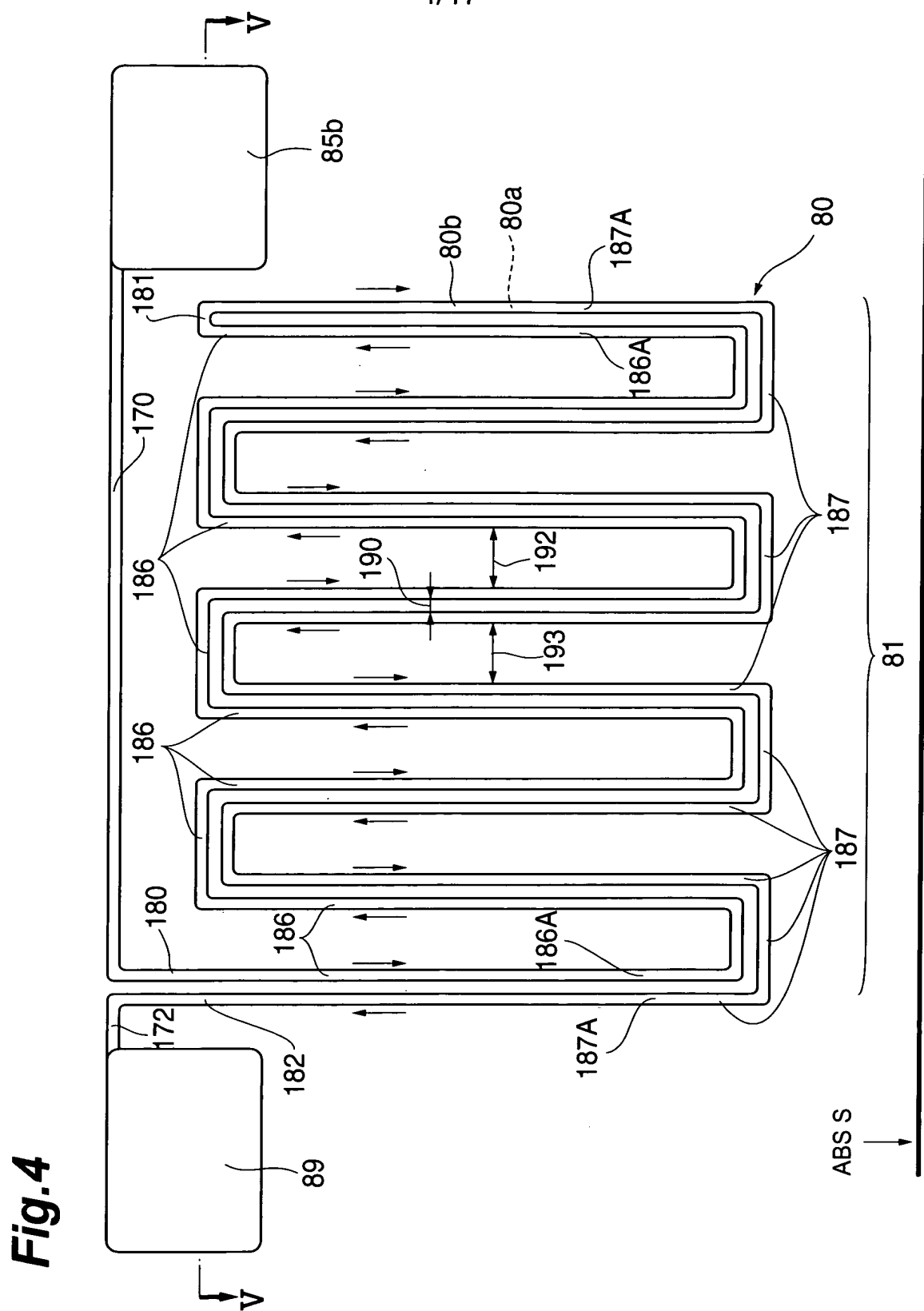
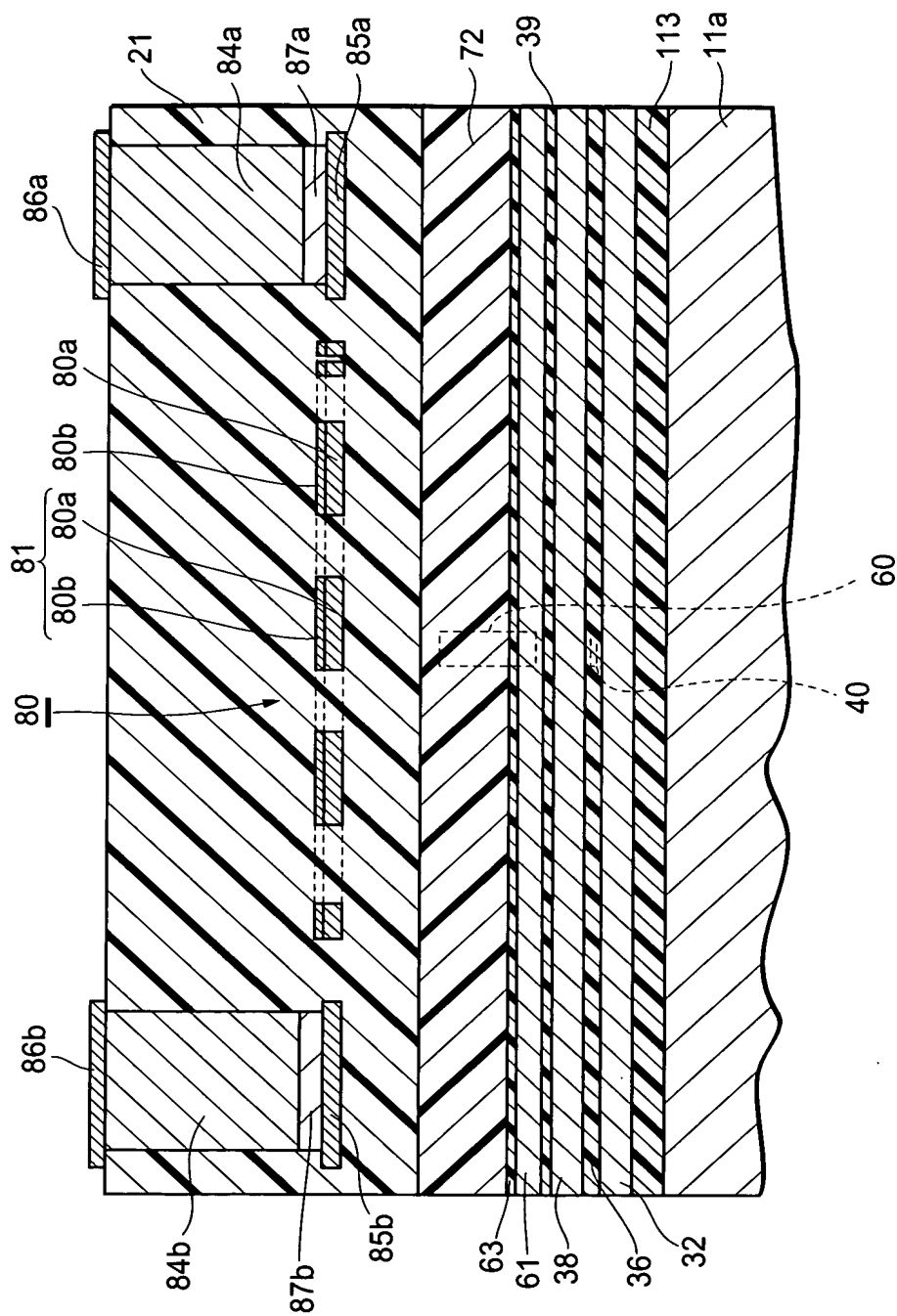


Fig.5



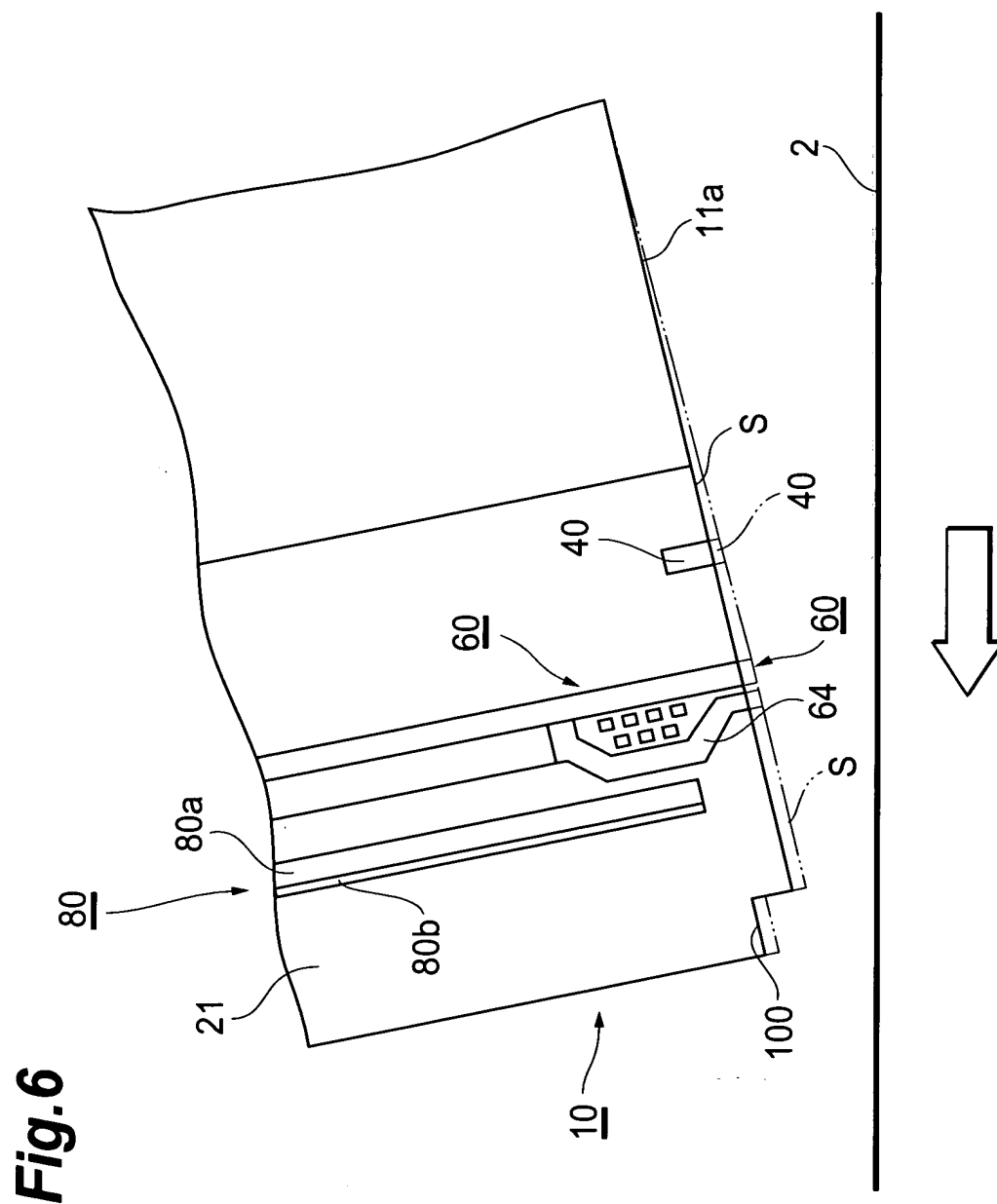


Fig.8

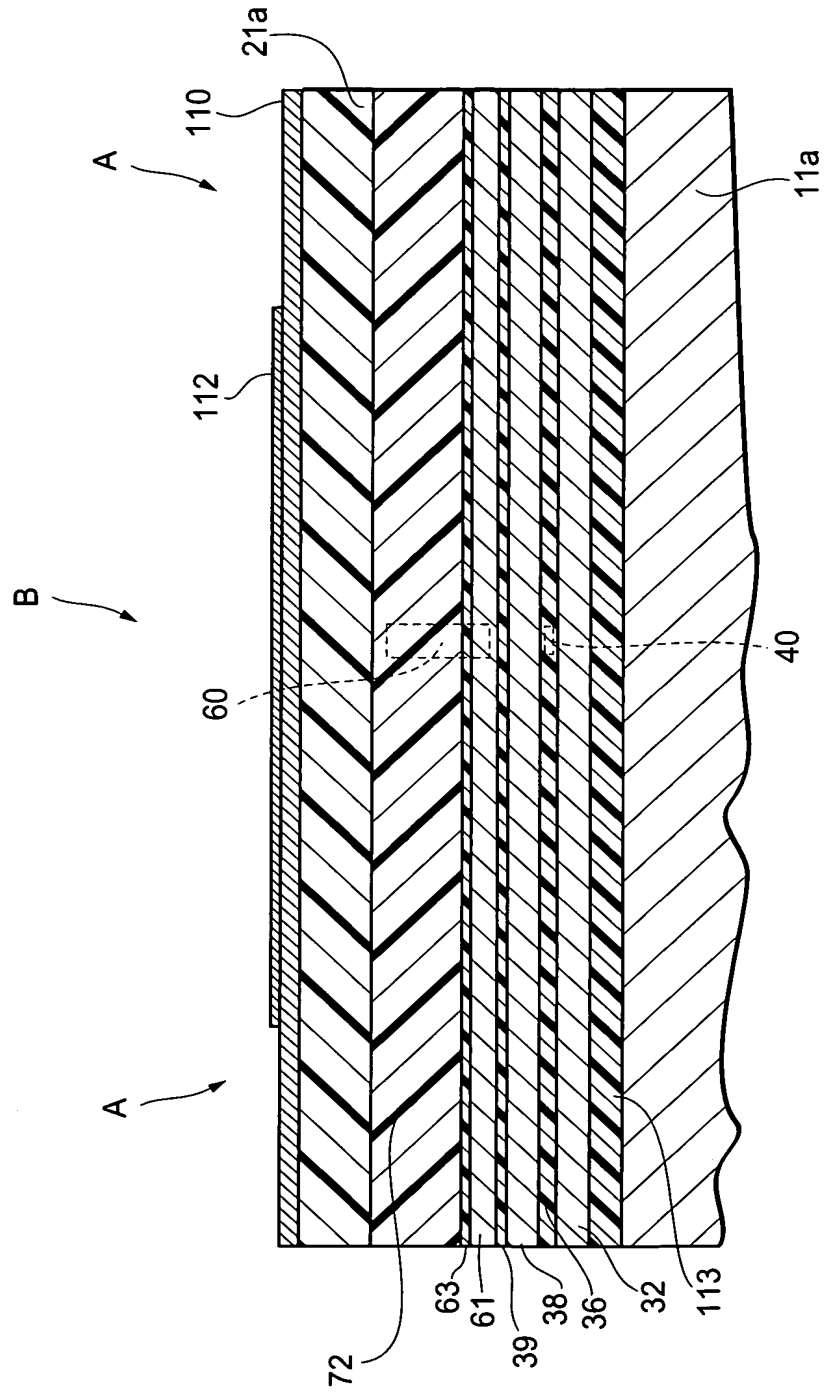


Fig.9

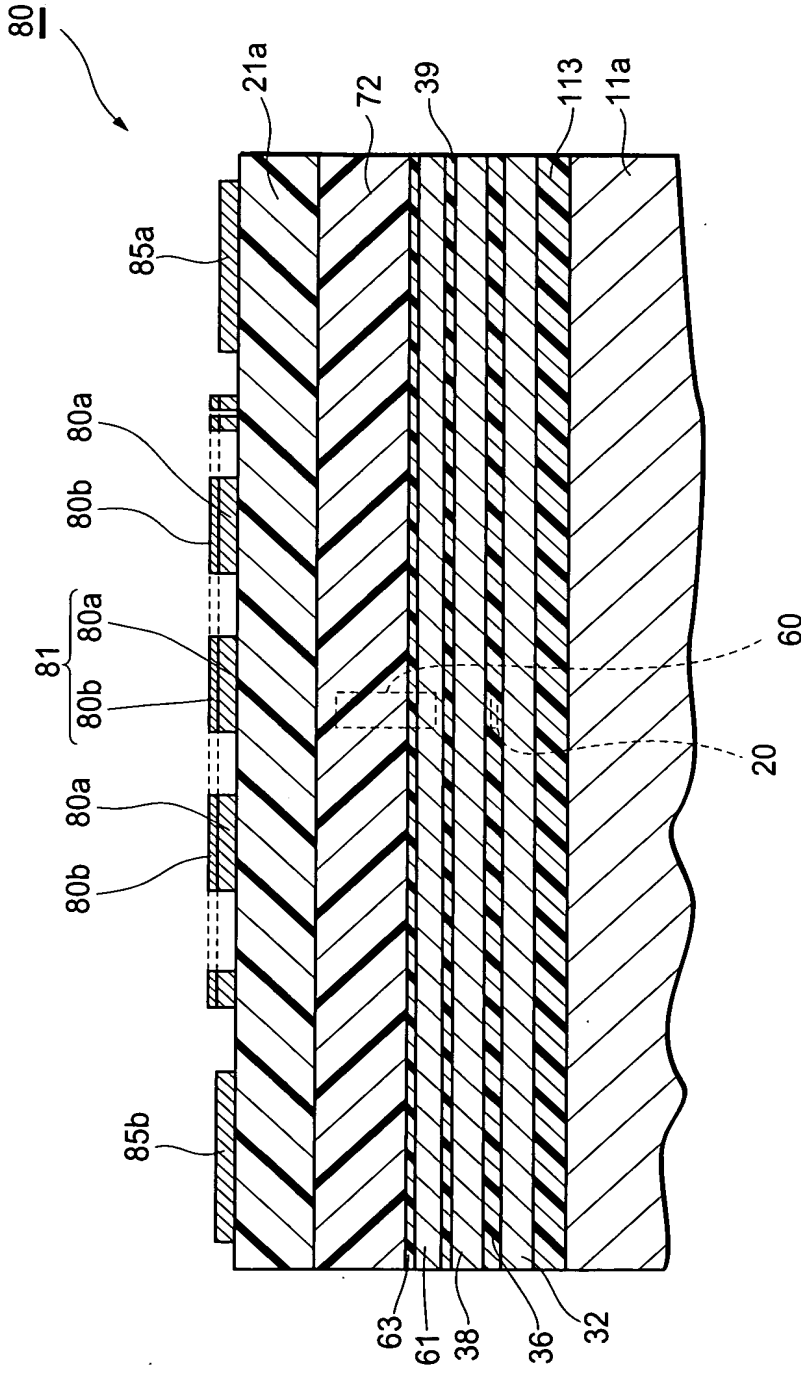


Fig.10

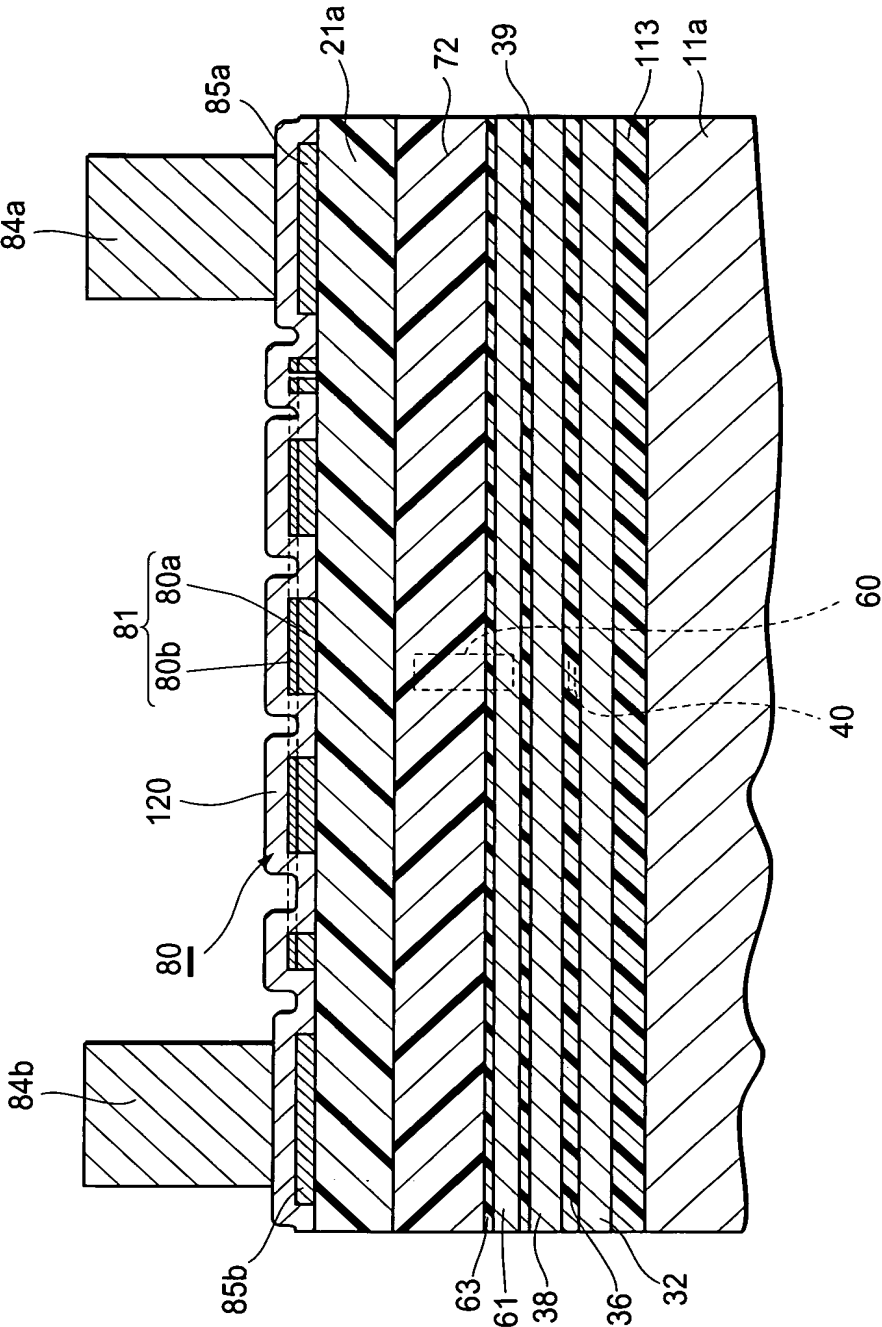


Fig.11

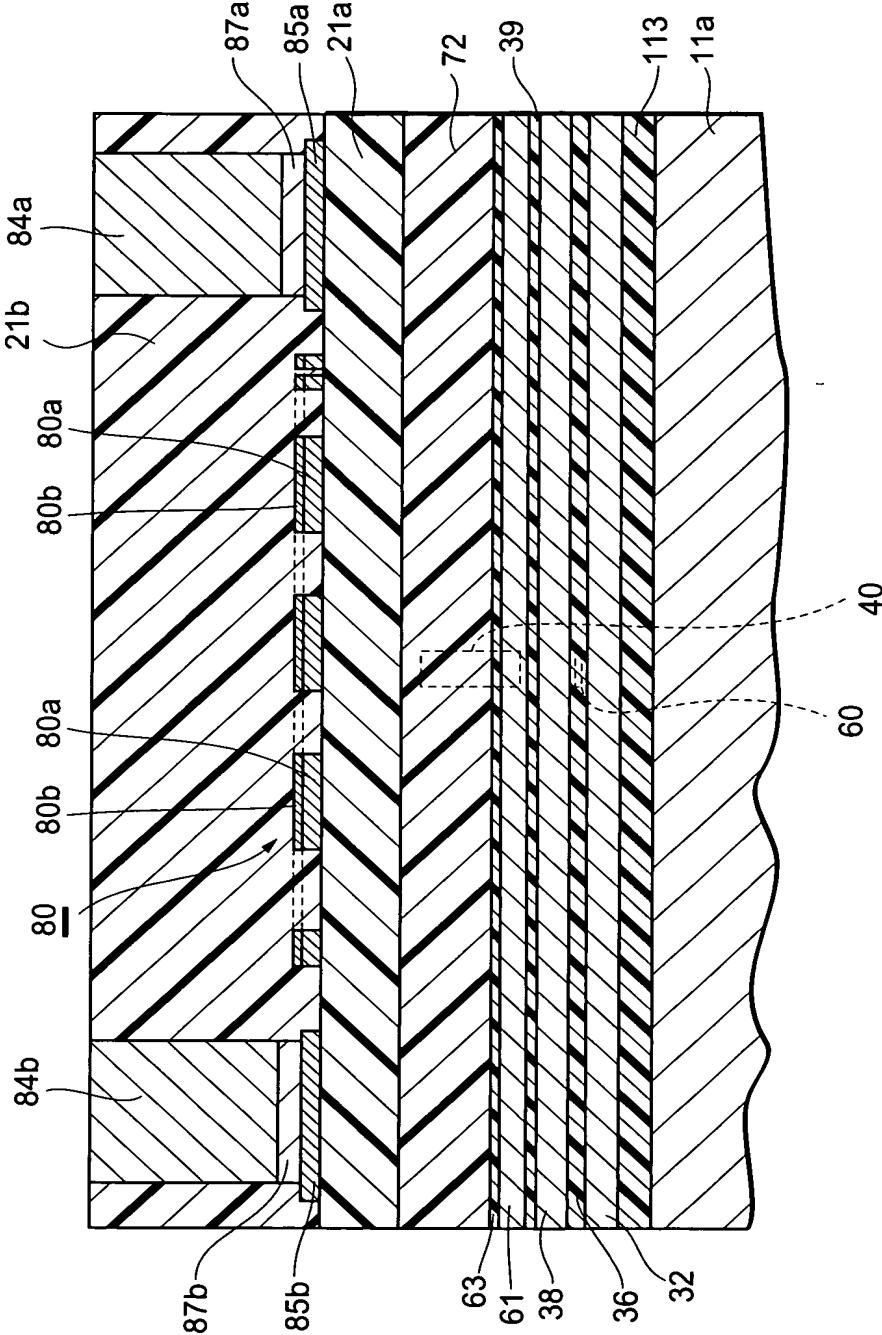


Fig.12

	MATERIAL OF FIRST LAYER	RESISTIVITY OF MATERIAL OF FIRST LAYER ($\mu\Omega \cdot \text{cm}$)	MATERIAL OF SECOND LAYER	RESISTIVITY OF MATERIAL OF SECOND LAYER ($\mu\Omega \cdot \text{cm}$)	RATIO OF RESISTIVITY OF MATERIAL OF SECOND LAYER TO RESISTIVITY OF MATERIAL OF FIRST LAYER (—)	THICKNESS OF FIRST LAYER (nm)	THICKNESS OF SECOND LAYER (nm)	SHEET RESISTANCE OF HEATER (Ω)	SHEET RESISTANCE VARIATION (%)
COMPARATIVE EXAMPLE1	NiFe	23	—	—	—	150 140	—	1.533 1.643	7.2
EXAMPLE1	NiFe	23	NiFeNb (Nb5wt%)	45	2.0	150	20 10	1.436 1.483	3.3
EXAMPLE2	NiFe	23	NiFeNb (Nb10wt%)	70	3.0	150	20 10	1.469 1.500	2.1
EXAMPLE3	NiFe	23	NiFeNb (Nb14wt%)	90	3.9	150	20 10	1.485 1.509	1.6
EXAMPLE4	NiFe	23	NiFeNb (Nb20wt%)	120	5.2	150	20 10	1.495 1.514	1.3
EXAMPLE5	NiFe	23	Ti	180	7.8	150	20 10	1.508 1.520	0.8
EXAMPLE6	NiFe	23	Ta	180	7.8	150	20 10	1.508 1.520	0.8

Fig.13

	MATERIAL OF FIRST LAYER	RESISTIVITY OF MATERIAL OF FIRST LAYER ($\mu \Omega \cdot \text{cm}$)	MATERIAL OF SECOND LAYER	RESISTIVITY OF MATERIAL OF SECOND LAYER ($\mu \Omega \cdot \text{cm}$)	RATIO OF RESISTIVITY OF MATERIAL OF SECOND LAYER TO RESISTIVITY OF MATERIAL OF FIRST LAYER (—)	THICKNESS OF FIRST LAYER (nm)	THICKNESS OF SECOND LAYER (nm)	SHEET RESISTANCE OF HEATER (Ω)	SHEET RESISTANCE VARIATION (%)
COMPARATIVE EXAMPLE2	Cu	3	—	—	—	120	—	0.250	9.2
						110		0.273	
EXAMPLE7	Cu	3	AuCu (Cu5at%)	7.5	2.5	120	20	0.231	3.9
						10	10	0.240	
EXAMPLE8	Cu	3	AuNi (Ni5at%)	10.5	3.5	120	20	0.238	2.5
						10	10	0.244	
EXAMPLE9	Cu	3	AuNi (Ni7at%)	12	4.0	120	20	0.240	2.0
						10	10	0.2449	
EXAMPLE10	Cu	3	AuNi (Ni10at%)	15	5.0	120	20	0.242	1.7
						10	10	0.246	
EXAMPLE11	Cu	3	NiFe	23	7.7	120	20	0.245	0.8
						10	10	0.247	
EXAMPLE12	Cu	3	CoFe	20	6.7	120	20	0.244	1.2
						10	10	0.247	

Fig.14

	MATERIAL OF FIRST LAYER	RESISTIVITY OF MATERIAL OF FIRST LAYER ($\mu\Omega\cdot\text{cm}$)	MATERIAL OF SECOND LAYER	RESISTIVITY OF MATERIAL OF SECOND LAYER ($\mu\Omega\cdot\text{cm}$)	RATIO OF RESISTIVITY OF MATERIAL OF SECOND LAYER TO RESISTIVITY OF MATERIAL OF FIRST LAYER (—)	THICKNESS OF FIRST LAYER (nm)	THICKNESS OF SECOND LAYER (nm)	SHEET RESISTANCE OF HEATER (Ω)	SHEET RESISTANCE VARIATION (%)
COMPARATIVE EXAMPLE3	Au	3.5	—	—	—	120	—	0.292	8.9
						110		0.318	
EXAMPLE13	Au	3.5	AuCu (Cu5at%)	7.5	2.1	120	20	0.266	4.5
							10	0.278	
EXAMPLE14	Au	3.5	AuCu (Ni10at%)	10	2.9	120	20	0.276	2.5
							10	0.283	
EXAMPLE15	Au	3.5	AuCu (Ni20at%)	14	4.0	120	20	0.281	1.8
							10	0.286	
EXAMPLE16	Au	3.5	AuNi (Ni15at%)	20	5.7	120	20	0.283	1.4
							10	0.287	
EXAMPLE17	Au	3.5	Ti	180	51.0	120	20	0.2907	0.2
							10	0.2912	
EXAMPLE18	Au	3.5	Ta	180	51.0	120	20	0.2907	0.2
							10	0.2912	

Fig.15

	MATERIAL OF FIRST LAYER	RESISTIVITY OF MATERIAL OF FIRST LAYER ($\mu \Omega \cdot \text{cm}$)	MATERIAL OF SECOND LAYER	RESISTIVITY OF MATERIAL OF SECOND LAYER ($\mu \Omega \cdot \text{cm}$)	RATIO OF RESISTIVITY OF MATERIAL OF SECOND LAYER TO RESISTIVITY OF MATERIAL OF FIRST LAYER (—)	THICKNESS OF FIRST LAYER (nm)	THICKNESS OF SECOND LAYER (nm)	SHEET RESISTANCE OF HEATER (Ω)	SHEET RESISTANCE VARIATION (%)
COMPARATIVE EXAMPLE4	Mo	16	—	—	—	150 140	—	1.067 1.143	7.1
EXAMPLE19	Mo	16	NiFeNb (Nb2wt%)	32	2.0	150	20 10	1.000 1.032	3.2
EXAMPLE20	Mo	16	NiFeNb (Nb5wt%)	45	2.8	150	20 10	1.018 1.042	2.4
EXAMPLE21	Mo	16	NiFeNb (Nb7wt%)	60	3.8	150	20 10	1.035 1.051	1.5
EXAMPLE22	Mo	16	NiFeNb (Nb12wt%)	80	5.0	150	20 10	1.039 1.053	1.3
EXAMPLE23	Mo	16	Ti	180	11.3	150	20 10	1.054 1.060	0.6
EXAMPLE24	Mo	16	Ta	180	11.3	150	20 10	1.054 1.060	0.6

Fig.16

	MATERIAL OF FIRST LAYER	RESISTIVITY OF MATERIAL OF FIRST LAYER ($\mu\Omega\cdot\text{cm}$)	MATERIAL OF SECOND LAYER	RESISTIVITY OF MATERIAL OF SECOND LAYER ($\mu\Omega\cdot\text{cm}$)	RATIO OF RESISTIVITY OF MATERIAL OF SECOND LAYER TO RESISTIVITY OF MATERIAL OF FIRST LAYER (—)	THICKNESS OF FIRST LAYER (nm)	THICKNESS OF SECOND LAYER (nm)	SHEET RESISTANCE OF HEATER (Ω)	SHEET RESISTANCE VARIATION (%)
COMPARATIVE EXAMPLE5	Rh	17.5	—	—	—	150 140	—	1.167 1.250	7.1
EXAMPLE25	Rh	17.5	NiFeNb (Nb2wt%)	32	1.8	150	20 10	1.087 1.126	3.6
EXAMPLE26	Rh	17.5	NiFeNb (Nb5wt%)	45	2.6	150	20 10	1.109 1.137	2.5
EXAMPLE27	Rh	17.5	NiFeNb (Nb10wt%)	70	4.0	150	20 10	1.129 1.148	1.7
EXAMPLE28	Rh	17.5	NiFeNb (Nb15wt%)	95	5.4	150	20 10	1.139 1.153	1.2
EXAMPLE29	Rh	17.5	Ti	180	10.3	150	20 10	1.152 1.159	0.6
EXAMPLE30	Rh	17.5	Ta	180	10.3	150	20 10	1.152 1.159	0.6

Fig.17

	MATERIAL OF FIRST LAYER	RESISTIVITY OF MATERIAL OF FIRST LAYER ($\mu\Omega \cdot \text{cm}$)	MATERIAL OF SECOND LAYER	RESISTIVITY OF MATERIAL OF SECOND LAYER ($\mu\Omega \cdot \text{cm}$)	RATIO OF RESISTIVITY OF MATERIAL OF SECOND LAYER TO RESISTIVITY OF MATERIAL OF FIRST LAYER (—)	THICKNESS OF FIRST LAYER (nm)	THICKNESS OF SECOND LAYER (nm)	SHEET RESISTANCE OF HEATER (Ω)	SHEET RESISTANCE VARIATION (%)
COMPARATIVE EXAMPLE6	CoFe	20	—	—	—	130 120	—	1.538 1.667	8.4
EXAMPLE31	CoFe	20	NiFeNb (Nb5wt%)	45	2.3	130	20 10	1.440 1.488	3.3
EXAMPLE32	CoFe	20	NiFeNb (Nb10wt%)	70	3.5	130	20 10	1.474 1.505	2.1
EXAMPLE33	CoFe	20	NiFeNb (Nb12wt%)	80	4.0	130	20 10	1.481 1.509	1.9
EXAMPLE34	CoFe	20	NiFeNb (Nb15wt%)	95	4.8	130	20 10	1.490 1.514	1.6
EXAMPLE35	CoFe	20	Ti	180	9.0	130	20 10	1.513 1.525	0.8
EXAMPLE36	CoFe	20	Ta	180	9.0	130	20 10	1.513 1.525	0.8